IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of Manabu KOBAYASHI, et al.
Application No.: 10/583,154
Filed: June 16, 2006
For: LUBRICANT BASE OIL AND METHOD OF PRODUCING THE SAME
Group Art Unit: 1797
Examiner: Chantel Graham
Confirmation No.: 2556

DECLARATION UNDER 37 C.F.R. § 1.132

I, Manabu Kobayashi, declare that:

I am one of the inventors of the above-captioned patent application.

I received my Master of Engineering from University of Tokyo in 1994, and have been employed by Japan Energy Corporation since 1994, where I have been engaged mainly in research and development of hydrotreating and hydrocracking process and catalysts. I also received my Doctor of Engineering from Shinshu University in 2009.

I have made the following experiments in order to evaluate a molecular structure of lubricant base oil produced by hydrocracking of Fischer-Tropsh waxes, which mainly consists of isoparaffin. I and the other inventors evaluated the influence of the branching numbers (Nb) and carbon numbers (Nc) of isoparaffin formed on the viscosity properties. As a result, we found that there is a suitable range of Nb and Nc to maximize viscosity properties, especially viscosity index of the lubricant base oil composed mainly of isoparaffins. We firmly believe this finding will be a key technology for producing lubricant base oils of extremely high performance.

Experimental Procedure

(Additional Comparative Example A1)

The same starting wax A and catalyst B as in Example 2 in the present specification are used for the isomerization. The same procedure as in Example 2 is repeated except that operation temperature is 360°C to obtain oil P-A1. The decreasing ratio of a fraction having a boiling point of not lower than 360°C derived from analytical results of oil P-A1 by the

distillation gas chromatography is 45.4% by weight. The oil P-A1 is dewaxed in the same manner as Example 1 to obtain dewaxed oil DWO-A1. The fraction having a boiling point of not lower than 360°C is fractional-distilled from the dewaxed oil DWO-A1 through a TBP distillation apparatus to obtain lubricant base oil L-A1. The analytical results of the lubricant base oil L-A1 about the same items as in Example 1 are shown in Table A. The total content of normal paraffin and isoparaffin is 100% by weight.

(Additional Comparative Example A2)

The same starting wax B and catalyst B as in Comparative Example 2 in the present specification are used for the isomerization. The same procedure as in Comparative Example 2 is repeated except that LHSV is 0.44 hr^{-1} and operation temperature is 350°C to obtain oil P-A2. The decreasing ratio of a fraction having a boiling point of not lower than 360°C derived from analytical results of oil P-A2 by the distillation gas chromatography is 30.9% by weight. The oil P-A2 is dewaxed in the same manner as Example 1 to obtain dewaxed oil DWO-A2. The fraction having a boiling point of not lower than 360°C is fractional-distilled from the dewaxed oil DWO-A2 through a TBP distillation apparatus to obtain lubricant base oil L-A2. The analytical results of the lubricant base oil L-A2 about the same items as in Example 1 are shown in Table A. The total content of normal paraffin and isoparaffin is 100% by weight.

(Additional Comparative Example A3)

The same starting wax B and catalyst B as in Comparative Example 2 in the present specification are used for the isomerization. The same procedure as in Comparative Example 2 is repeated except that LHSV is 0.44 hr^{-1} and operation temperature is 340°C to obtain oil P-A3. The decreasing ratio of a fraction having a boiling point of not lower than 360°C derived from analytical results of oil P-A3 by the distillation gas chromatography is 14.3% by weight. The oil P-A3 is dewaxed in the same manner as Example 1 to obtain dewaxed oil DWO-A3. The fraction having a boiling point of not lower than 360°C is fractional-distilled from the dewaxed oil DWO-A3 through a TBP distillation apparatus to obtain lubricant base oil L-A3. The analytical results of the lubricant base oil L-A3 about the same items as in Example 1 are shown in Table A. The total content of normal paraffin and isoparaffin is 100% by weight.

(Additional Comparative Example A4)

The same starting wax B and catalyst B as in Comparative Example 2 in the present specification are used for the isomerization. The same procedure as in Comparative Example 2 is repeated except that operation temperature is 350°C to obtain oil P-A4. The decreasing ratio of a fraction having a boiling point of not lower than 360°C derived from analytical results of oil

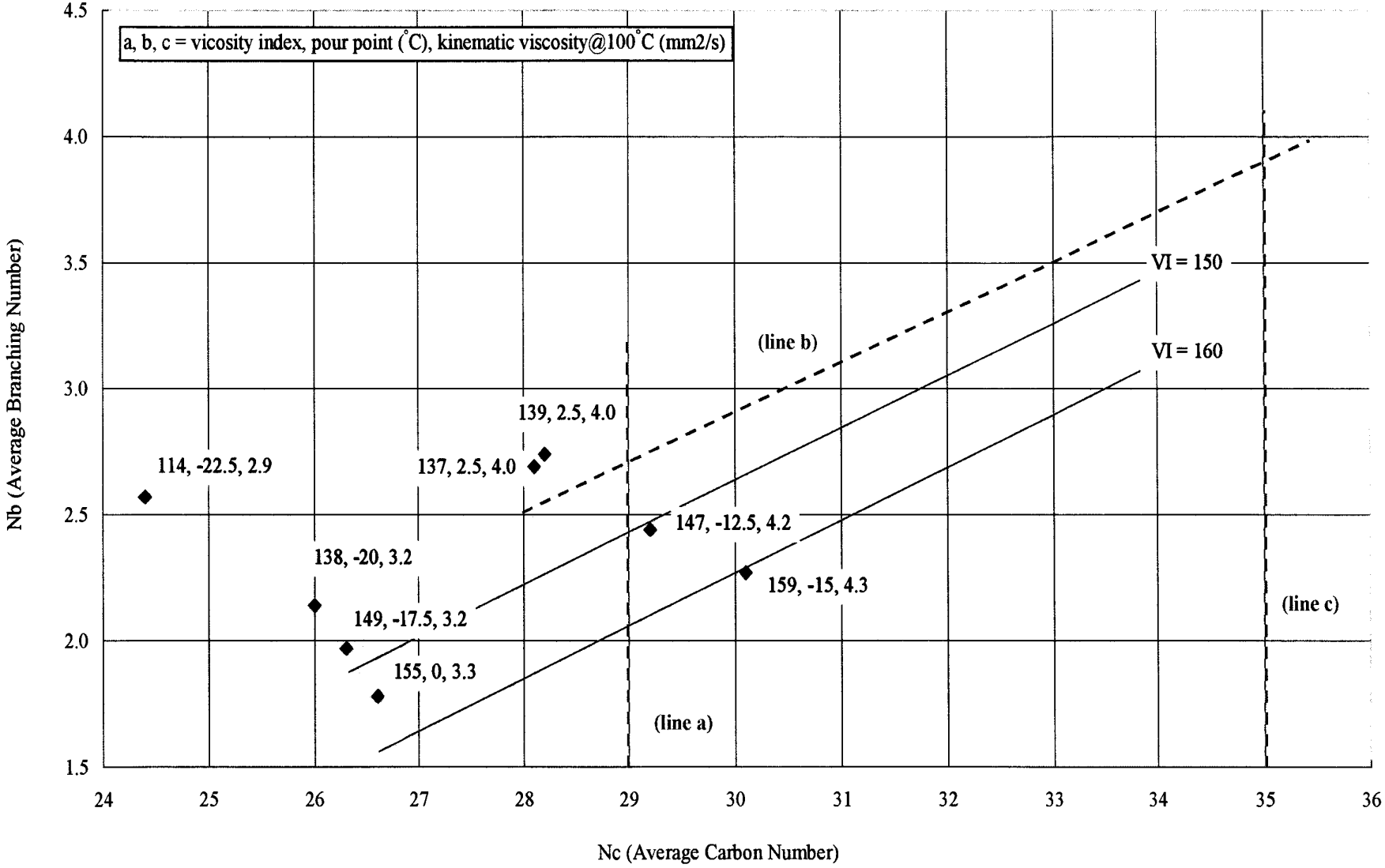
P-A4 by the distillation gas chromatography is 8.3% by weight. The oil P-A4 is dewaxed in the same manner as Example 1 to obtain dewaxed oil DWO-A4. The fraction having a boiling point of not lower than 360°C is fractional-distilled from the dewaxed oil DWO-A4 through a TBP distillation apparatus to obtain lubricant base oil L-A4. The analytical results of the lubricant base oil L-A4 about the same items as in Example 1 are shown in Table A. The total content of normal paraffin and isoparaffin is 100% by weight.

Furthermore, (1) the results obtained from the above additional Comparative Examples and (2) the results described in the original specification are summarized in the following Figure.

Table A

		Additional Comparative Example A1	Additional Comparative Example A2	Additional Comparative Example A3	Additional Comparative Example A4
Lubricant base oil		Lubricant base oil L-A1	Lubricant base oil L-A2	Lubricant base oil L-A3	Lubricant base oil L-A4
Kinematic Viscosity at 40°C	mm^2/s	16.7	11.9	11.8	12.0
Kinematic Viscosity at 100°C	mm^2/s	4.0	3.2	3.2	3.3
Viscosity index	–	139	138	149	155
Pour point	°C	2.5	-20	-17.5	0
Ratio of CH_3 carbon from ^{13}C-NMR analysis	%	16.7	15.9	15.1	14.2
Ratio of CH_2 carbon from ^{13}C-NMR analysis	%	73.9	75.4	77.1	78.7
Ratio of CH carbon from ^{13}C-NMR analysis	%	9.4	8.7	7.8	7.2
Average carbon number from distillation	number	28.1	26.0	26.3	26.6
Average branch number	number	2.7	2.1	2.0	1.8
Yield of lubricant base oil	wt%	54.1	63.0	66.8	65.9

Figure. Molecular Strucural Parameters and Properties as Lubricant Base Oils Prepared from FT waxes and α-olefins



Summary

As seen from the above Table A and Figure, there is a suitable range of Nb and Nc to maximize viscosity properties, especially viscosity index of the lubricant base oil composed mainly of isoparaffins. I firmly believe this finding will be a key technology for producing lubricant base oils of extremely high performance.

I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: April 13, 2010 Declarant: M. Kobayashi

Manabu Kobayashi